PATENT
Conf. No. 7462

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Andrew James Cameron	Examiner:	Samir M. Shah
Serial No.	10/609,068	Group Art Unit:	2856
Filed:	June 27, 2003	Docket No.	47406.013000
Title:	A METHOD FOR ANALYZING MATERIAL DENSITY VARIATIONS ON A MULTI-LAYER PRINTED CIRCUIT BOARD		
Customer No.:	33717		

AMENDMENT

Commissioner for Patents
Post Office Box 1450
Alexandria, Virginia 22313-1450

Sir/Madam:

In response to the Office Action mailed March 6, 2006, kindly enter the following amendments:

Amendments to the Drawings are appended as page 12 of this paper;

Amendments to the Specification begin on page 3 of this paper;

Amendments to the Claims begin on page 5 of this paper; and

Remarks begin on page 9 of this paper.

AMENDMENTS TO THE DRAWINGS

See appended page 12 for Replacement Drawings.

AMENDMENTS TO THE SPECIFICATION

Please replace paragraph **[0023]** with the following:

[0023] FIG. **2** shows an exemplary depiction of a virtual grid system **20**, formed on a PCB **22**, that includes a set of grid elements **24** and grid co-ordinates **26** (e.g., the X co-ordinate of a grid element could be Q and Y co-ordinate could be 15) that identify each grid element **24** on the top layer of PCB **22**. In this example, each of the grid elements **24** is rectangular in shape, but it could be of any other appropriate polygonal shape. The Z co-ordinate, ~~thought~~ though not shown here in this two dimensional view, but will be apparent in FIG. **6**, is also used to identify grid elements in lower layers of the PCB.

Please replace paragraph **[0034]** with the following:

[0034] The root cause of thickness variation is unbalanced copper. Some areas within a PCB are very dense with copper and others have little or no copper when viewed through the board in the z-axis. This is what causes variation in panel thickness. How much variation is determined by the following characteristics, ~~assumes~~ assuming that all things are equal in the PCB manufacturing process: (i) distance from a low density area to a high density area, (ii) amount of variation from a low density area to a high density areas. The final analysis computes the slope (delta) between low and high copper density areas.

Please replace paragraph **[0037]** with the following:

[0037] ~~FIG. 8 shows~~ FIGS. **8a-8p** show an exemplary chart for computing the density of the material in a multi-layer PCB. Specifically, each number in the chart corresponds to the total amount of copper in a grid element on a given layer. The grid element label is shown along the vertical axis and the layer label is shown along the horizontal axis. The total copper in grid (over all layers) column shows the result obtained by using equation (1). The average amount of copper in the PCB, also shown in the cart, is computed using

equation (2). The column showing the percentage of the average (or the density of the material in each grid element) is computed by using equation (3).

AMENDMENTS TO THE CLAIMS

Claim 1 (Currently amended): A method for determining the density variations of a material on a multi-layer printed circuit board, the method comprising:

forming a grid system on each layer in the multi-layer printed circuit board;

determining the area occupied by the material in each grid element, each grid element having unique grid system co-ordinates of the grid system, on each of the layers in the multi-layer printed circuit board; and

computing a measure of the density from the area of the material, in ~~said each~~ grid ~~element~~ elements, ~~on~~ in at least two of the layers in the multi-layer printed circuit board.

Claim 2 (Original): The method according to claim 1, wherein the material includes copper (Cu).

Claim 3 (Original): The method according to claim 1, wherein said each grid element is rectangular.

Claim 4 (Currently amended): The method according to claim 1, further including the steps of:

adding the area occupied by the material in ~~the~~ each grid element in neighbor layers having the same grid system co-ordinates to obtain a sum area ~~for said grid element, said each grid element having the same co-ordinates in all the layers~~; and

determining an average of the sum area over all grid elements.

Claim 5 (Currently amended): The method according to claim 4, further including the step of dividing the sum area ~~for the each grid element~~ with the average of the sum area over all grid elements to compute the measure of the density of the material for said ~~grid~~ multi-layer printed circuit board.

Claim 6 (Original): The method according to claim 5, further including the step of generating a contour map showing the variation in the measure of the density of the material on the multi-layer printed circuit board.

Claim 7 (original): The method according to claim 4, further including the step of predicting a defect in the multi-layer printed circuit board from the measure of the density of the material.

Claim 8 (Currently amended): A method for predicting a defect on a multi-layer printed circuit board, the method comprising:

forming a grid system on each layer in the multi-layer printed circuit board;

determining the area occupied by the material in each grid element, of the grid system, on each of the layers in the multi-layer printed circuit board;

computing a measure of the density from the area of the material, in ~~each~~ grid ~~element~~ elements, ~~on~~ in at least two of the layers in the multi-layer printed circuit board;

predicting a defect in the multi-layer printed circuit board from the measure of the density of the material.

Claim 9 (Currently amended): The method according to claim 8, further including the steps of:

adding the area occupied by the material in the each grid element in neighbor layers having the same co-ordinates to obtain a sum area ~~for said grid element, said each grid element having the same co-ordinates in all the layers~~; and

determining an average of the sum area over all grid elements.

Claim 10 (Currently amended): The method according to claim 9, further including the step of dividing the sum area ~~for the each grid element~~ with the average of the sum area over all grid elements to compute the measure of the density of the material for said ~~grid~~ multi-layered printed circuit board.

Claim 11 (Original): The method according to claim 10, further including the step of generating a contour map showing the variation in the measure of the density of the material on the multi-layer printed circuit board.

Claim 12 (Original): The method according to claim 9, wherein the material includes copper (Cu).

Claim 13 (Original): The method according to claim 9, wherein said each grid element is rectangular.

Claim 14 (Currently amended): A system for determining the density variations of a material on a multi-layer printed circuit board, the system comprising:

means for forming a grid system on each layer in the multi-layer printed circuit board;

means for determining the area occupied by the material in each grid element, of the grid system, on each of the layers in the multi-layer printed circuit board; and

means for computing a measure of the density from the area of the material, in ~~said each~~ grid ~~element~~ elements, ~~on~~ in at least two layers of the multi-layer printed circuit board.

Claim 15 (Original): The system according to claim 14, wherein the material includes copper (Cu).

Claim 16 (Original): The system according to claim 14, wherein said each grid element is rectangular.

Claim 17 (Currently amended): The system according to claim 14, further including:

means for adding the area occupied by the material in the each grid element in neighbor layers having the same co-ordinates to obtain a sum area ~~for said grid element, said each grid element having the same co-ordinates in all the layers~~; and

means for determining an average of the sum area over all grid elements.

Claim 18 (Currently amended): The system according to claim 17, further including means for dividing the sum area ~~for the each grid element~~ with the average of the sum area to compute the measure of the density of the material for said ~~grid~~ multi-layer printed circuit board.

Claim 19 (Original): The system according to claim 18, further including means for generating a contour map showing the variation in the measure of the density of the material on the multi-layer printed circuit board.

Claim 20 (Original): The system according to claim 17, further including means for predicting a defect in the multi-layer printed circuit board from the measure of the density of the material.

REMARKS

The office action issued by the Examiner on March 6, 2006 and the citations referred to in the office action have been carefully considered. The specification and drawing figures have been amended as suggested by the Examiner. The Examiner's thorough review of the specification is appreciated. Independent claims 1, 8, and 14 have been amended to read as set forth above. In addition, dependent claims 4, 5, 9, 10, 17 and 18 have been amended. Reconsideration and passage of the application to issue are therefore earnestly solicited.

Drawings

The examiner objected to Figure 1 for failure to label this figure as prior art. A properly labeled Replacement Sheet 1 containing Figures 1 and 2 is appended herewith. In the Replacement Sheet 1 of 22, Figure 1 has been labeled "Prior Art" and Figure 2 has been modified by the addition of an arrow "20" pointing to the grid as required by the description on page 6 of the specification.

Specification

Several typographical errors were identified by the Examiner in the Office Action. The specification has been amended so as to read as set forth above to correct these errors as suggested by the Examiner.

Claim Objections

Claims 4, 5, 9, 10, 17, and 18 stand objected to as not containing proper antecedent basis for the term "said grid," and identified confusion between "grid element," "grid system," and "each grid element." Claims 1, 8, and 14 have been amended and dependent claims 4, 5, 9, 10 17, and 18 have been amended specifically to address these objections. It is respectfully submitted that these terms in all of these claims are now sufficiently clear so as to obviate these claim objections.

Claim Rejections under 35 USC § 102

Claims 1-3, 8, and 14-16 stand rejected as anticipated by U.S. Patent No.6,484,300 to Kim, et al. (Kim). Amended independent claims 1, 8 and 14 now specifically recite that the method includes operations of determining the area occupied by the material in each grid element, each grid element having unique grid system co-ordinates of the grid system on each of the layers ... and computing a measure of the density from the area of the material in grid elements in at least two of the layers in the multi-layer printed circuit board. It is respectfully submitted that this use of areal density in at least two of the layers patentably distinguishes over all of the prior art and therefore each of the independent claims, and the claims depending therefrom, are now allowable.

Allowable Subject Matter

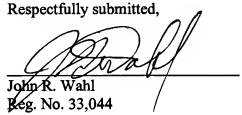
The Examiner indicated that claims 4-7, 9-13, and 17-20 would be allowable if rewritten in independent form. It is respectfully submitted that the claim amendments set forth above obviate the objections for antecedent basis and therefore are now fully allowable in their present dependent form.

Conclusion

Claims 1 through 20 remain pending in the application. Claims 1-20 are believed to now be allowable and in allowable form. This Amendment is believed to be responsive to all points in the Office Action such that the application is now in order for allowance. Accordingly, reconsideration of the application and allowance thereof is courteously solicited. Should the Examiner have any remaining questions or concerns he is urged to contact the undersigned attorney by telephone at the number below to expeditiously resolve such concerns.

The Director is authorized to charge any additional fee(s) or any underpayment of fee(s), or to credit any overpayments to **Deposit Account Number 50-2638**. Please ensure that Attorney Docket Number 47406.013000 is referred to when charging any payments or credits for this case.

Respectfully submitted,



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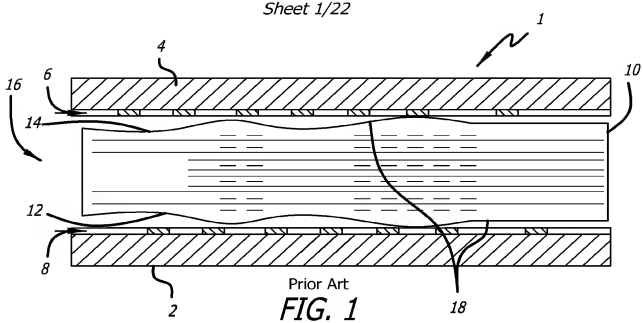

Prior Art

FIG. 1

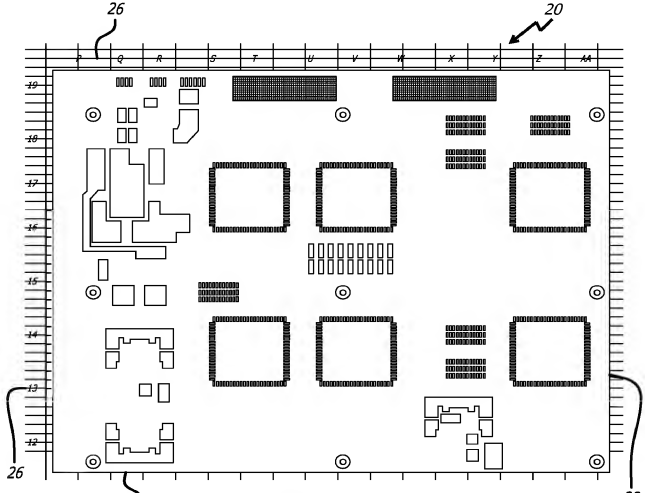

FIG. 2